

WHAT IS CLAIMED:

1. A method of providing Global Positioning System (GPS) time assistance to a mobile station comprising:
  - 5 transmitting a message from a networked GPS time server to a mobile station, the message including GPS referenced time information indicating an elapsed GPS referenced time interval at the networked GPS time server between receiving a request for GPS time assistance at the networked GPS time server and transmitting the message to the mobile station.
- 10 2. A method according to Claim 1 wherein the message comprises an Internet Control Message Protocol message.
3. A method according to Claim 1 wherein the GPS referenced time
  - 15 information comprises a first GPS referenced time at which the networked GPS time server received the request and a second GPS referenced time at which the networked GPS time server transmitted the message.
4. A method according to Claim 3 wherein the GPS referenced time
  - 20 information further comprises:
    - a mobile station referenced request time at which the mobile station transmitted the request to the networked GPS time server.
5. A method according to Claim 4 wherein the message comprises a
  - 25 single ICMP message including the first and second GPS referenced times and the mobile station request time.
6. A method according to Claim 4 further comprising:
  - 30 receiving the message at the mobile station at a mobile station referenced reception time at which the mobile station received the message from the networked GPS time server;
    - determining a delay associated with propagation of the message from the networked GPS time server to the mobile station based on the mobile station referenced reception time and the mobile station referenced request time; and

determining a mobile station GPS time based on the second GPS referenced time at which the networked GPS time server transmitted the message and the delay.

7. A method according to Claim 6 wherein determining the delay further comprises:

determining the delay based on the mobile station referenced reception time, the mobile station referenced request time, and the first and second GPS referenced times.

8. A method according to Claim 1 wherein transmitting is preceded by:  
accessing GPS referenced time from the networked GPS time server responsive to the request to provide a first GPS referenced time at the networked GPS time server when the message is received; and

accessing GPS referenced time from the networked GPS time server responsive to the request to provide a second GPS referenced time at the networked GPS time server when the message is transmitted.

9. A method of providing Global Positioning System (GPS) time assistance to a mobile station comprising:

transmitting a request for GPS time assistance information from a mobile station to a networked GPS time server at a first mobile station referenced time;

receiving the request for GPS time assistance information at the networked GPS time server at a first GPS referenced time;

transmitting a single ICMP message from the networked GPS time server to the mobile station at a second GPS referenced time, the single ICMP message including at least the first and second GPS referenced times;

receiving the single ICMP message at the mobile station at a second mobile station referenced time; and

determining a current GPS referenced time at the mobile station based on the first and second GPS referenced times and the first and second mobile station referenced times.

10. A method according to Claim 9 wherein transmitting the single ICMP message further comprises:

transmitting the single ICMP message including the first mobile station referenced time.

11. A method according to Claim 9 wherein the first and second GPS  
5 referenced times indicate an elapsed GPS referenced time interval at the networked  
GPS time server between receiving the request for GPS time assistance at the  
networked GPS time server and transmitting the message to the mobile station.

12. A method according to Claim 9 wherein the determining further  
10 comprising:  
determining a delay associated with propagation of the message from the  
networked GPS time server to the mobile station based on a difference between the  
first and second mobile station referenced times; and  
determining a current GPS referenced time based on the second GPS  
15 referenced time at which the networked GPS time server transmitted the message and  
the delay associated with propagation of the message.

13. A computer-readable medium having computer-executable instructions  
for performing the steps recited in Claim 9.

14. A method of determining location information for a mobile station  
20 included in a wireless communications network comprising:  
determining GPS referenced time at a mobile station derived from a single  
message from a networked GPS time server, the single message including GPS  
25 referenced time information and delay information associated with propagation of the  
message to the mobile station.

15. A method according to Claim 14 wherein the message comprises an  
Internet Control Message Protocol message.

16. A method according to Claim 14 wherein the GPS referenced time  
30 information comprises a first GPS referenced time at which the networked GPS time  
server received the request and a second GPS referenced time at which the networked  
GPS time server transmitted the message.

17. A computer-readable medium having computer-executable instructions for performing the steps recited in Claim 14.

5 18. A method according to Claim 14 wherein the GPS referenced time information comprises GPS Time-Of-Week (TOW) information and GPS sub-frame information indicating GPS time having a greater accuracy than the GPS TOW information alone.

10 19. A method according to Claim 14 wherein the GPS referenced time information further comprises:

GPS data bit count information indicating a bit position within the GPS sub-frame information indicating GPS time having a greater accuracy than the GPS TOW information and the GPS sub-frame information alone.

15 20. A method according to Claim 19 wherein the GPS referenced time information further comprises:

coarse acquisition code information indicating a coarse acquisition code repetition count within the GPS data bit count information indicating GPS time having a greater accuracy than the GPS TOW information, the GPS sub-frame information, and the GPS data bit count information alone.

21. A networked server for providing Global Positioning System (GPS) time assistance comprising:

25 a networked GPS time server circuit configured to transmit a message to a mobile station via a network, the message including GPS referenced time information indicating an elapsed GPS referenced time interval at the networked GPS time server circuit between receiving a request for GPS time assistance at the networked GPS time server circuit and transmitting the message to the mobile station.

30 22. A networked server according to Claim 21 wherein the message comprises an Internet Control Message Protocol (ICMP) message.

23. A networked server according to Claim 21 wherein the request for GPS time assistance comprises an ICMP time request message and the message comprises an ICMP time response message.

5 24. A networked server according to Claim 22 wherein GPS referenced time information comprises GPS Time-Of-Week (TOW) information and GPS sub-frame information indicating GPS time having a greater accuracy than the GPS TOW information alone.

10 25. A networked server according to Claim 24 wherein the GPS referenced time information further comprises:

GPS data bit count information indicating a bit position within the GPS sub-frame information indicating GPS time having a greater accuracy than the GPS TOW information and the GPS sub-frame information alone.

15 26. A networked server according to Claim 25 wherein the GPS referenced time information further comprises:

coarse acquisition code information indicating a coarse acquisition code repetition count within the GPS data bit count information indicating GPS time having a greater accuracy than the GPS TOW information, the GPS sub-frame information, and the GPS data bit count information alone.

27. A networked server according to Claim 22 wherein the GPS referenced time information comprises:

25 GPS Time-Of-Week (TOW) information; and

four bits of GPS sub-frame information indicating a word position within a frame of the GPS TOW information;

five bits of GPS data bit count information indicating a bit position within the GPS sub-frame information; and

30 coarse acquisition code information indicating a coarse acquisition code repetition count within the GPS data bit count information.

28. A networked server according to Claim 27 wherein the GPS TOW information is separated into at least two ICMP messages, or excludes at least some of the most significant bits of the GPS TOW information.

5 29. A networked server according to Claim 27 wherein the coarse acquisition code information comprises between one and five bits inclusive.

30. A networked server according to Claim 22 wherein the ICMP message comprises a ping message.

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31. A networked server for providing Global Positioning System (GPS) time assistance comprising:

a GPS time source configured to provide GPS referenced time information;

and

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an IP stack including an ICMP compliant protocol layer configured to request GPS referenced time information from the GPS time source responsive to ICMP time stamp request messages and configured to transmit ICMP time reply messages including the GPS referenced time information.

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32. A networked server according to Claim 31 wherein the GPS referenced time information comprises:

a first GPS referenced time associated with when the ICMP time request message was received by the networked server; and

25 a second GPS referenced time associated with when the ICMP time replay message is transmitted by the networked server.

33. A networked server according to Claim 31 further comprising:

an application layer of the IP stack; and

30 an application configured to receive the GPS time assistance requests from mobile stations and configured to provide GPS time assistance information in response thereto, wherein the application is configured to access the ICMP compliant protocol layer through the application layer of the IP stack.

34. A networked server according to Claim 31 further comprising:

a GPS time source switch coupled between the IP stack and the GPS time source, wherein the GPS time source switch is configured to direct requests for GPS referenced time information to the GPS time source and direct GPS referenced time information from the GPS time source to the IP stack and configured to direct requests for server time information to a server time source and direct server referenced time information from the server time source to the IP stack.

35. A networked server according to Claim 31 wherein GPS referenced time information comprises GPS Time-Of-Week (TOW) information and GPS sub-frame information indicating GPS time having a greater accuracy than the GPS TOW information alone.

36. A networked server according to Claim 35 wherein the GPS referenced time information further comprises:

GPS data bit count information indicating a bit position within the GPS sub-frame; information indicating GPS time having a greater accuracy than the GPS TOW information and the GPS sub-frame information alone.

37. A networked server according to Claim 36 wherein the GPS referenced time information further comprises:

coarse acquisition code information indicating a coarse acquisition code repetition count within the GPS data bit count information indicating GPS time having a greater accuracy than the GPS TOW information, the GPS sub-frame information, and the GPS data bit count information alone.

38. A computer-readable medium having computer-executable instructions for implementing the networked server recited in Claim 31.

39. A GPS enabled mobile station comprising:  
a processor circuit configured to determine current GPS referenced time at a mobile station derived from a single message from a networked GPS time server, the single message including GPS referenced time information and delay information associated with propagation of the message to the mobile station.

40. A GPS enabled mobile station according to Claim 39 wherein the message comprises an Internet Control Message Protocol message.

41. A GPS enabled mobile station according to Claim 39 wherein the GPS  
5 referenced time information comprises a first GPS referenced time at which the networked GPS time server received the request and a second GPS referenced time at which the networked GPS time server transmitted the message.

42. A computer-readable medium having computer-executable instructions  
10 for performing the steps recited in Claim 39.

43. A GPS enabled mobile station according to Claim 39 wherein the GPS referenced time information comprises GPS Time-Of-Week (TOW) information and GPS sub-frame information indicating GPS time having a greater accuracy than the  
15 GPS TOW information alone.

44. A GPS enabled mobile station according to Claim 39 wherein the GPS referenced time information further comprises:  
GPS data bit count information indicating a bit position within the GPS sub-  
20 frame information indicating GPS time having a greater accuracy than the GPS TOW information and the GPS sub-frame information alone.

45. A GPS enabled mobile station according to Claim 44 wherein the GPS referenced time information further comprises:  
25 coarse acquisition code information indicating a coarse acquisition code repetition count within the GPS data bit count information indicating GPS time having a greater accuracy than the GPS TOW information, the GPS sub-frame information, and the GPS data bit count information alone.